Appendix A: Table of Contents for Volume I of the Technical Report

Appendix B: Characteristics of the National Samples
Population 3 (Final Year of Secondary School)

B

AUSTRALIA

Structure of Upper Secondary System

Secondary education is provided for either five or six years depending on the length of primary education in the state. Australia's secondary schools provide a comprehensive education, although students can focus on academic/pre-university studies, including humanities and art, mathematics and science, commerce, and other disciplines, or they can focus on vocationally oriented studies.

Students Tested in Mathematics and Science Literacy

Australia tested students in the final year of secondary school, Grade 12, in government, Catholic, and independent schools.

Students Tested in Advanced Mathematics and Physics

Advanced Mathematics: students in the final year of secondary school, Grade 12, enrolled in mathematics courses (varies across states) preparing them for post-secondary study, and students in Grade 12 who took such mathematics courses during Grade 11.

Physics: students in the final year of secondary school, Grade 12, enrolled in Year 12 physics.

Coverage and Exclusions

Very small schools, schools for adult education, and schools in geographically remote locations were excluded.

Sample Design

- Definitions of subpopulations:

  MO Grade 12 students having taken the following advanced mathematics courses, but not year 12 physics:

State	Course Name
New South Wales	3-unit or 4-unit math
Victoria	Change and Approximations
Queensland	Math I + Math II, or Math B+ Math C
Western Australia	Calculus
South Australia	Math 1 + Math 2
Tasmania	Math Stage 3 + special units
Northern Territory	Math 1 + Math 2
Australian Capital Terr.	Double major or major-minor in math

OP Grade 12 students having taken Year 12 Physics but not advanced mathematics

MP Grade 12 students having taken both Year 12 Physics and advanced mathematics course (defined above)

OO Grade 12 students having taken neither Year 12 Physics nor advanced mathematics course

- For planning purposes, final-year population was estimated to be 65% OO, 5% OP, 18% MO, and 12% MP.
- Sample of 132 schools selected from state sampling frames with probability proportional to school size.
- Within selected schools, lists of pupils belonging to each subpopulation were compiled and simple random samples of students were drawn from each subpopulation list.

AUSTRIA

Structure of Upper Secondary System

Academic and vocational schools form the upper secondary schooling in Austria. Academic secondary school (AHS) is a four-year cycle of pre-academic general education. Students may specialize in certain areas, but generally study a whole range of subjects. At the end of the cycle, students take a matriculation examination (*Matura*) which, upon passing, enables them to enter university.

There are three variations of vocational schools in Austria. Higher-technical and vocational (BHS) is a five-year cycle in which students study a similar academic curriculum to that in the AHS, but also study theoretical subjects relevant to future professions. Students train for careers in industry, trade, business, agriculture, or human service occupations. The final examination is similar to the AHS *Matura* and enables students to continue to university or obtain certain levels of vocational qualification. The final year of this cycle is Grade 13.

Intermediate-technical and vocational schools (BMS) are basically full-time schools equivalent to the dual system of school and apprenticeship (see below). These schools provide training in apprenticed trades and general education. The cycle is one to four years, but typically lasts three to four years. Successful completion results in vocational licenses which are sometimes more extensive than the ones given by the dual system. There are also higher teacher training colleges that represent an alternative route from the ninth year (grade) onwards.

In the system of dual vocational education – Apprenticeship/Berufsschulen (BS) – apprentices in business and industry receive practical vocational training at their place of work and also attend part-time vocational schools, *Berufsschulen*. Students typically attend the *Berufsschule* one day a week where some element of general education is included. The length of the course is from two to four years, but is three years for most students. The vocational qualification licenses the recipient to work in a legally defined trade.

Students Tested in Mathematics and Science Literacy

Austria tested students in their final year of academic schools (AHS), Grade 12, their final year of higher technical and vocational (BHS), Grade 13, and their final year of medium technical and vocational (BMS), Grades 10, 11, or 12, depending on the vocational program of the student, and students in their final year of the apprenticeship (BS).

Students Tested in Advanced Mathematics and Physics

Advanced Mathematics: students in their final year of the academic or higher technical track, taking courses in advanced mathematics.

Physics: students in their final year of the academic or higher technical track, taking courses in physics.

Coverage and Exclusions

Special schools for disabled students and colleges offering programs less than 3 years were excluded. Schools that participated in the TIMSS Population 2 (seventh and eighth grade) were assessment excluded.

Sample Design

- Definitions of subpopulations:

  MO Not applicable

  OP Not applicable

  MP Students in their final year, Grade 12, of AHS

  OO Students in their final year, Grade 12, of BS, BMS, and BHS

- For planning purposes, final-year population was estimated to have 62,000 OO and 18,000 MP students.

- Samples for each subpopulation were drawn from track-specific frames. Within selected units, classrooms were selected randomly: one classroom in AHS units; two classrooms in BMS units; one classroom in BHS units; and two classrooms in BS units.

CANADA

Structure of Upper Secondary System

Secondary education in Canada is comprehensive, although students can focus on academic/pre-university studies or vocationally oriented studies. The first years of secondary school are devoted to compulsory subjects, with some optional subjects included. In the latter years, the number of compulsory subjects is reduced, permitting students to spend more time on specialized programs that prepare them for the job market, or to take specific courses they need to meet the entrance requirements of the college or university of their choice. Senior high school ends in Grade 12 in all provinces except Quebec, where it ends in Grade 11. In Ontario, some students complete secondary schooling at the end of Grade 12, whereas others continue for an extra year to complete the Ontario Academic Credits (OAC) necessary for admission to university. Students in Quebec continue from Grade 11 to either a two- or three-year training program prior to entry into tertiary education or the workplace.

Students Tested in Mathematics and Science Literacy

Canada tested students in Grade 12 in all provinces except Quebec where students in Grades 13 and 14 (depending on program) were tested. In Ontario, students completing the OAC in Grade 13 also were tested.

Students Tested in Advanced Mathematics and Physics

Advanced Mathematics: students in their final year in mathematics courses preparing them for postsecondary study (varies by province), except in Quebec where students in the two-year science program were tested.

Physics: students in their final year in physics courses preparing them for postsecondary study (varies by province), except in Quebec where students in the two-year science program were tested.

Coverage and Exclusions

Very small schools and schools in Prince Edward Island were excluded. At the time of data collection, a number of final-year students in Ontario had already graduated in the prior semester and were excluded de facto.

Sample Design

- Definitions of subpopulations:

  All of Canada except Quebec:

  MO Grade 12 students taking advanced mathematics but not physics (as defined below)

  OP Grade 12 students taking physics but not advanced mathematics (as defined below)

  MP Grade 12 students taking both advanced mathematics and physics (as defined below)

OO Grade 12 students not taking either advanced mathematics nor physics (as defined below)

Province	Physics	Advanced Mathematics
Northwest, Yukon Terr.	Physics 12	Math 12
British Columbia	Physics 12	Math 12
Alberta	Physics 30	Math 31
Saskatchawan	Physics 30	Math 31
Manitoba	Physics 300	Math 200 or 305
Ontario	OAC Physics	OAC Math
New Brunswick	Grade 12 Physics	
Nova Scotia	Physics 441 or 541	Math 441 or 541
New Foundland	Physics 3204 or 4225	Math 3201, Calculus 3105 or 4225

Quebec:

MO Not applicable

OP Not applicable

MP Students enrolled in two-year science *cegep* program

OO All other *cegep* students

- For planning purposes, final-year population was estimated to be 60-80% OO and 15-20% OP or MO; percent MP unknown prior to testing.
- 389 schools were sampled from province sampling frames with probability proportional to school size.
- Within selected schools, lists of pupils belonging to each subpopulation were compiled and simple random samples of pupils were drawn from each subpopulation list.

CYPRUS

Structure of Upper Secondary System

Academic schools (lycea) and technical schools form the upper secondary schooling in Cyprus. At the lyceum, which comprises Grades 10, 11, and 12, students can choose one of five groups of subjects – classical (arts), mathematics and science, economics, commercial/secretarial, and foreign languages.

In technical schools, also three years in duration, students can take technical courses with particular emphasis on mathematics and science. Graduates of these programs typically follow further studies in colleges or universities. Technical schools also offer vocational programs in which students in the final year follow a training program in industry for two days a week and attend school for three days a week. In the vocational section, more emphasis is given to practical skills. The aim of public technical schools is to provide industry with technicians and craftsmen in various specializations such as mechanical and automobile engineering, computers, electronics, building, graphic arts, dressmaking, gold smithery, shoe manufacturing, and many others. Cyprus' private secondary schools are oriented towards commercial and vocational education and provide a six year education program.

Students Tested in Mathematics and Science Literacy

Cyprus tested students in Grade 12 of lycea and technical schools.

Students Tested in Advanced Mathematics and Physics

Advanced Mathematics: students in their final year in the mathematics/science program of study at the lyceum.

Physics: students in their final year in the mathematics/science program of study at the lyceum.

Coverage and Exclusions

Private schools and vocational schools/programs were excluded.

Sample Design

- Definitions of subpopulations:

  MO Not applicable

  OP Not applicable

  MP Grade 12 students in mathematics/science program of study at the lyceum

  OO All other Grade 12 students

- For planning purposes, final-year population was estimated to have 5,600 OO and 1,100 MP.

- All 29 in-scope schools were sampled. All MP students in these schools were tested. In other tracks, a random sample of 1 student in 10 was drawn.

CZECH REPUBLIC

Structure of Upper Secondary System

At the time of testing there were three types of secondary schools in the Czech Republic: gymnasium, technical, and vocational. The gymnasium is a four-, six-, or eight-year general secondary school providing demanding academic training for higher education. Students are in one of three streams in the gymnasium: humanities, science, or general education. Secondary technical schools, four or five years in duration, provide a broad general education as well as specialized study in a particular field (e.g., nursing, certain technical areas, tourism, library science, accounting, etc.). Students successfully completing the gymnasium or secondary technical school, and passing the final examination (maturita), are eligible to apply to institutions of higher education. Secondary vocational schools, with programs of two, three, four, or five years duration, provide practical vocational training as well as general education, with the aim to prepare students for occupations. These professional schools specialize mostly in engineering and technical areas.

Secondary schooling ends in different years depending on the type of school and the course of study within school. In almost all secondary technical school and gymnasia, students complete their education at the end of Grade 12, although a few complete their studies in Grade 13. In vocational schools, students may end in Grades 10, 11, 12, or 13, depending on their type of vocation.

Since the time of the TIMSS testing (1995), the Czech system has been modified to reflect an extension of basic school. Beginning in 1996, Grade 9 became compulsory (until this decision was made, Grade 9 was an optional grade, attended by 14% of the age cohort in 1993/94). This means that currently all secondary technical and gymnasium students complete their education in Grade 13 and most vocational students complete their studies in Grade 12.

Students Tested in Mathematics and Science Literacy

The Czech Republic tested students in their final year of each type of school. In technical schools and gymnasia, students in Grades 12 and 13 were tested. In vocational schools, students in Grades 10, 11, 12, and 13 were tested, depending on their vocation.

Students Tested in Advanced Mathematics and Physics

Advanced Mathematics: gymnasium students in their final year of study, Grade 12 or 13.

Physics: gymnasium students in their final year of study, Grade 12 or 13.

Coverage and Exclusions

Medical schools, schools for the disabled, and dance schools were excluded.

Sample Design

- Definitions of subpopulations:

  MO Not applicable

  OP Not applicable

  MP Students in their final year of gymnasium

  OO Students in their final year of vocational and technical schools

- For planning purposes, the final-year population was estimated to be 80% OO and 20% MP
- 150 schools were sampled from track-specific frames with probability proportional to school size.
- Within selected schools, lists of classes were established and one classroom from each school was selected at random.

DENMARK

Structure of Upper Secondary System

The general upper secondary programs are comprised of the general upper secondary certificates (*Studentereksamen*), the higher preparatory exam (HF) for mature students, the higher commercial exam (HHX), and the higher technical exam (HTX). The first two programs are taught at the Gymnasium and the last two at commercial and technical schools, respectively. All programs have a duration of three years except for the HF which is two years. The aim of the first two programs is primarily to prepare students for further studies at the tertiary level. The HHX and HTX prepare pupils for higher education but qualify also as final vocational education.

Vocational upper secondary programs encompass approximately 100 different specializations including vocational education and training, training for social affairs and health officers, agricultural education, and maritime education. Vocational training in Denmark is rooted in the apprenticeship tradition, but a wide-ranging modernization has been carried out over the past 30 years. This modernization has taken into account the lack of capacity among small and medium-sized enterprises to organize and carry out such training and reflects the need for a continuous updating of such programs.

Students Tested in Mathematics and Science Literacy

Denmark tested students in Grade 12 of the general secondary and vocational schools.

Students Tested in Advanced Mathematics and Physics

Advanced Mathematics: Grade 12 mathematics and physics students in the gymnasium and mathematics students in their final year, Grade 12, of the technical or higher preparation tracks.

Physics: Grade 12 mathematics and physics students in the gymnasium and physics students in their final year, Grade 12, of the technical track.

Coverage and Exclusions

Disabled and non-native language students were excluded.

Sample Design

- Definitions of subpopulations:

  MO Grade 12 mathematics students in the academic, technical, or higher preparation tracks taking advanced mathematics

  OP Not applicable

  MP Grade 12 students in the academic track of gymnasium taking advanced mathematics and advanced physics and students in the technical track taking advanced mathematics and advanced physics

  OO All other students

- For planning purposes, final-year population was estimated to be 22% MO; 4% MP; remaining OO.
- 130 schools (all schools) sampled.
- In each school, one classroom of language arts, one of mathematics, and one of physics were drawn. Some students were tested more than once for national assessment purposes and were later identified and removed from the TIMSS sample.
- Booklet rotation was not carried out according to TIMSS procedures.
- Classrooms were not sampled according to TIMSS procedures.

FRANCE

Structure of Upper Secondary System

There are two types of upper secondary schools in France: *lycées d'enseignement général et technologique*, or upper secondary school, for Grades 10 to 12, and *lycées professionnels*, or vocational upper secondary school, which may end at Grade 11 or Grade 13.

In the *lycée d'enseignement général et technologique*, students in Grades 10, 11, and 12 are in either the general track or the technological track. In Grade 10, there are both common areas of study and optional courses in the general and technological tracks. All students at this level take mathematics and science courses. In Grade 11, the different tracks are strongly differentiated, leading to corresponding types of *baccalauréats*. The *baccalauréat général* has three main tracks: scientific (S), literary (L), and economic and social (ES). The *baccalauréat technologique* has four major tracks within it: tertiary sciences and technologies (STT), industrial sciences and technologies (STI), medical-social sciences (SMS), and laboratory sciences and technologies (STL). The type and amount of mathematics and science taken by *lycée* students is different for each of the tracks within the general and technological tracks. The final year of the general and technological tracks is Grade 12.

Vocational Grade 10 is the first year of a program leading to the *Brevet d'études professionnelles* (BEP) or to the *Certificat d'aptitude professionnelle* (CAP). Most pupils achieve a *Brevet d'études professionnelles*, which is granted after Grade 11. About 50 percent of students achieving this diploma decide to continue their studies, either by joining the technological track through a *classe d'adaptation* or by continuing in vocational secondary for an additional two years to achieve the *baccalauréat professionnel*. Their choice depends mainly on their results, but also on the area of their studies and employment prospects with a *Brevet d'études professionnelles*. The *baccalauréat* leads directly to university studies. The final year for a student in the *lycée professionnel* is either Grade 11 or Grade 13, depending on whether or not they plan to continue their studies.

Students Tested in Mathematics and Science Literacy

France tested students in the final year of preparation for the *baccalauréat* (nonrepeaters of this final year). This included students in Grade 12 preparing for the *baccalauréat général ou technologique*, and in Grade 13 for the *baccalauréat professionnel* (vocational). Also tested were students in the final year (nonrepeaters of this year) of preparation for the *Brevet d'études professionnelles* (BEP) or the *Certificat d'aptitude professionnelle* (CAP) who will not continue towards a *baccalauréat*.

Students Tested in Advanced Mathematics and Physics

Advanced Mathematics: students in their final year of the scientific track, Grade 12, preparing for the *baccalauréat général.*

Physics: students in their final year of the scientific track, Grade 12, preparing for the *baccalauréat général.*

Coverage and Exclusions

Overseas territories were excluded.

Sample Design

- Definitions of subpopulations:

  MO Not applicable

  OP Not applicable

  MP Grade 12 students enrolled in the scientific track of lycées d'enseignement général et technologique

  OO All other students

- For planning purposes, final-year population was estimated to be 23% MP; remaining OO.

- Two independent samples were drawn. The first sample consisted of 71 schools from the lycées d'enseignement général et technologique and vocational schools (lycées professionnels); within these schools a sample of students was selected from the final year for the Mathematics and Science Literacy sample. The second sample consisted of 69 lycées d'enseignement général et technologique where the scientific track is offered; within these schools a sample of students in the scientific track was drawn for the Advanced Mathematics and Physics assessments.

GERMANY

Structure of Upper Secondary System

The upper secondary education system, Grades 11 to 13, in Germany is comprised of two types of schools – gymnasia or comprehensive schools and vocational schools. Education is compulsory up to age 18. In the upper grades of gymnasium, beginning in Grade 11, students can choose specializations within a rather complicated framework that allocates approximately one-third of instruction time to languages and arts, one-fourth to social studies (civic education, history, religion or philosophy), one-third to mathematics and science, and one-twelfth to sports. Upon successful completion of the final examination at the end of Grade 12 or 13 (final year depends on the Laender) a student may attend university.

Those students interested in vocational training have a variety of options. A dual system combines general education and theoretical instruction in the specific area of occupational training in part-time schools (*Berufsschule*), and practical training in one of over 500,000 authorized companies or businesses (*Betriebe*). Usually students in the dual system attend school two days a week and work the other three days at a company in a training program. At the company, students are supervised and taught by accredited trainers according to the training regulations in effect pertaining to the occupation. In larger companies, students often receive additional instruction in company schools. There is also a broad range of full-time vocational schools, such as *Fachgymnasien*, where students are instructed in economic and technical fields and admission requirements for university-level studies are fulfilled. Other types of schools are *Fachoberschulen* that certify for further specialized scientific training at institutions of higher education as well as *Berufsfachschulen* that provide occupational training for careers in social and health services and business.

Students Tested in Mathematics and Science Literacy

Germany tested students in their final year in the academic track of upper secondary education and the vocational education programs. This corresponded to Grade 13 in the Laender of the former West Germany and to Grade 12 in the Laender of the former East Germany.

Students Tested in Advanced Mathematics and Physics

Advanced Mathematics: students in their final year, Grade 12 or 13 depending on the Laender, in advanced mathematics courses (3 to 5 periods per week).

Physics: students in their final year, Grade 12 or 13, depending on the Laender, in physics courses (3 to 5 periods per week).

Coverage and Exclusions

Waldorf schools were excluded.

Sample Design

- Definitions of subpopulations:

  MO Grade 12 or 13 (depending on Laender) students in gymnasia and comprehensive schools taking advanced mathematics (3 to 5 periods a week) but not physics

  OP Not applicable

  MP Grade 12 or 13 (depending on Laender) students in gymnasia and comprehensive schools taking advanced mathematics and physics (3 to 5 periods a week)

  OO All other students

- For planning purposes, final-year population was estimated to be 31% MO; 14% MP; 55% OO

- Schools were sampled from track-specific school sampling frames with probability proportional to school size. All final-year students in gymnasia and comprehensive schools were in sample. Within sampled full-time vocational schools, one classroom was selected at random. In sampled part-time vocational schools, two sampling algorithms were used. In about half of these schools, one classroom was drawn from the set of classes in the final year. In the other half, each school was assigned at random to one of five trades. One class of that trade was then selected at random within the school.

- Data collection was conducted in 1995 in vocational schools and in 1996 in gymnasia.

GREECE

Structure of Upper Secondary System

The upper secondary system in Greece is a three-year program, Grades 10 to 12, taken in the general (academic) *Lyceum*, in the multibranch, semi-comprehensive *Lyceum* or in the technical-vocational *Lyceum*. Some students attend vocational and technical schools that provide two years of education, ending at Grade 11. In the general *Lyceum*, students in Grades 10 and 11 take the same courses. Students in the final grade may follow one out of four option streams in order to prepare them for tertiary education entry examinations. The four possible streams are science and engineering, medical, humanities, and social science. They may follow an alternative cycle if they do not choose to continue their education at the tertiary level. In the technical-vocational and multibranch schools, a wide range of option cycles of vocational and/or general education is provided.

Students Tested in Mathematics and Science Literacy

Greece participated only in the advanced testing and therefore tested a limited portion of their final-year students in the *Lyceum*. It tested students in Grade 12 of the general (academic) *Lyceum* as well as students in Grade 12 of the multibranch *Lyceum* taking advanced courses in mathematics and/or science in preparation for university disciplines requiring mathematics and/or science.

Students Tested in Advanced Mathematics and Physics

Advanced Mathematics: students in their final year, Grade 12, of the general (academic) *Lyceum* and of the multibranch *Lyceum* taking advanced courses in mathematics and/or science in preparation for university disciplines requiring mathematics.

Physics: students in their final year, Grade 12, of the general (academic) *Lyceum* and of the multibranch *Lyceum* taking advanced courses in mathematics and/or science in preparation for university disciplines requiring physics.

Coverage and Exclusions

Greece limited testing to advanced mathematics and physics students in general lycea and multi-branch lycea. Evening classes for adults. Adults attending evening classes were not considered part of the target population.

Sample Design

- Definitions of subpopulations:

  MP Students in science and engineering branches of general lycea and multi-branch lycea taking advanced mathematics and advanced physics

  Subpopulations not defined further: Greece tested only advanced mathematics and physics students.

- For planning purposes, the final-year population was estimated to be 14.9% MP.
- 60 academic schools (lycea) were sampled with probability proportional to school size from a national list. One class was drawn at random from the final-year classes in each school.

HUNGARY

Structure of Upper Secondary System

The upper secondary system in Hungary consists of five types of schools: a four-year academic secondary school (Grades 9 to 12), a four-year vocational secondary school (Grades 9 to 12), a three-year trade school (Grades 9 to 11), and a six-year or an eight-year academic program (Grades 7 to 12 or 5 to 12). Academic secondary schools offer general education and, for many students, lead to university. Vocational secondary schools prepare students for the work force (often technical vocations) or, alternatively, graduates may enter universities that match their vocational orientation. Trade schools and training schools emphasize practical knowledge and skills to train skilled workers. Students in the trade schools leave school after Grade 10 and spend their final year in out-of-school practice.

Students Tested in Mathematics and Science Literacy

Hungary tested students in their final year of academic secondary and vocational schools (Grade 12) and students in the final in-school year of trade school (Grade 10).

Students Tested in Advanced Mathematics and Physics

Students were not tested in advanced mathematics or physics in Hungary.

Coverage and Exclusions

Very small schools were excluded.

Sample Design

- Definitions of subpopulations:

  No subpopulations were defined: only tested in Mathematics and Science Literacy

- School sample was drawn from list ordered by probability proportional to school size.

- Within each sampled school, one classroom was randomly selected.

ICELAND

Structure of Upper Secondary System

There are four main types of upper secondary schools in Iceland:

1 Grammar schools offer a four-year academic program of study leading to matriculation (stúdentspróf), i.e., higher education entrance examination. Students who complete the course satisfactorily are entitled to apply for admission to university.

2 Industrial-vocational schools primarily offer vocational courses that prepare students for skilled trades. They also offer studies leading to a technical matriculation examination.

3 Comprehensive schools provide academic courses comparable to those of the grammar schools and vocational training comparable to that offered by industrial-vocational schools, as well as other specialized vocational training courses.

4 Specialized vocational schools offer training for specific vocations (Seamen's and navigational colleges, The Fish Processing School, marine engineering colleges, The Technical College of Iceland, fine arts colleges, agricultural colleges, The Icelandic College for Pre-school Teachers, The Icelandic College of Social Pedagogy).

At the upper secondary level, general academic education is primarily organized as a four-year course leading to matriculation, but two-year courses are also offered. The main areas of study of these two-year courses are in education, physical education, and commerce. They are organized as part of the course leading to matriculation (70 units of the 140 required) and students in these shorter courses can therefore continue on to matriculation. Such courses are usually intended as preparatory studies for other courses within the school or at specialized vocational schools.

Traditional grammar schools and upper secondary comprehensive schools are virtually the only schools offering education leading to matriculation. There are basically six courses of academic study leading to matriculation. These are studies in languages, sociology, economics, physical education, natural sciences, and physics. Additional fine arts studies, in music, for example, may lead to matriculation, as does a technical program offered as a follow-up to vocational training.

Vocational training takes place in comprehensive schools, industrial-vocational schools, and specialized vocational schools. Subjects included in vocational programs of study can be grouped as general academic subjects, theoretical vocational subjects, and practical vocational subjects. The length of the courses offered varies from one to ten semesters. Many forms of vocational training award students certification for certain types of employment. This applies especially to study in certified trades, but also to some other studies, such as the training of nurses aides and qualified skippers.

Students Tested in Mathematics and Science Literacy

Iceland tested students who were to graduate that year from an upper secondary school, that is, students in Grades 12, 13, and 14.

Students Tested in Advanced Mathematics and Physics

Students were not tested in advanced mathematics or physics.

Sample Design

- Definitions of subpopulations:

  No subpopulations were defined: only tested in Mathematics and Science Literacy

- All schools and all students in their final year of secondary school were asked to participate.

ISRAEL

Structure of Upper Secondary System

Secondary schools provide three different tracks: academic, technical and vocational, and agricultural. There are four school types: comprehensive (which cater to all three tracks); technical/vocational (vocational track); general schools (academic track); and agricultural schools (agricultural track). Programs are from two to four years and end in Grade 12. Technical education offers a range of courses, including design, computer studies, industrial automation studies, electronics, and telecommunications. Graduates of the technical track are encouraged to serve in technical units of the Israeli defense forces and to continue their studies in institutes of higher education.

Students Tested in Mathematics and Science Literacy

Israel tested students in the Hebrew public education system only. Students in their final year of secondary school, Grade 12, were tested, in all three tracks.

Students Tested in Advanced Mathematics and Physics

Advanced Mathematics: students in advanced mathematics courses in Comprehensive and General schools.

Physics: students in physics courses in Comprehensive and General schools.

Coverage and Exclusions

Only schools in the Hebrew public school system were included in the sample. The Jewish Orthodox Independent Education System, special education, and non-Jewish schools were excluded.

Sample Design

- Definitions of subpopulations:

  MO Students in general and comprehensive schools taking advanced mathematics but not physics

  OP Not applicable

  MP Students in general and comprehensive schools taking advanced mathematics and physics

  OO All other students

- For planning purposes, final-year population was estimated to be 70% OO; 20% MO, and 10% MP. The estimated number of students in final year was 67,000. There were estimated to be about 20,000 students in 270 general schools; about 18,000 students in 190 comprehensive schools, and 29,000 students in 330 vocational/agricultural schools.

- The sampling plan was as follows: 40 vocational/agricultural schools, 30 comprehensive schools, and 30 general schools were to be sampled with probability proportional to school size. In each school, one Language class was to be selected for the Mathematics and Science Literacy assessment; advanced mathematics and physics students, if any, were to be removed from sample. In the general and comprehensive schools, one mathematics class was to be drawn and MPs removed from mathematics testing. All MP students would be placed on a list and assigned one of nine test booklets.

- Problems were encountered with test booklet rotation, school tracking forms, classroom tracking forms, and student sampling. It was not possible to compute sampling weights.

ITALY

Structure of Upper Secondary System

There are four upper secondary school types lasting three, four, or five years: classical schools, art schools, technical schools, and vocational schools. Classical schools include the *Liceo Classico*, which prepares humanities students for university; the *Liceo Scientifico*, which prepares mathematics and science students for university; the *Instituto Magistrale* for primary teacher education; the *Scuola Magistrale* for preprimary teacher education; and the *Liceo Linguistico* which prepares language students for university. Art schools, including the *Liceo Artistico* and the *Instituti d'Arte*, train students in the visual arts and lead to university or fine arts academies.

Technical schools, *Instituti Technici*, provide a five-year program to prepare students for professional, technical, or administrative occupations in the agricultural, industrial, or commercial sector. These schools give students access to university. Vocational schools provide a three-year program to train students to become qualified first-level technicians. Students may study an additional two years at *Instituti Professionali* and obtain a "professional maturity" designation, giving access to university.

Students Tested in Mathematics and Science Literacy

Italy tested students in all types of schools in their final year of secondary school. The final grade of school depended on the focus of study within school type. Classical studies: *Liceo Classico* (Grade 13); *Liceo Scientifico* (Grade 13); *Instituto Magistrale* (Grade 12); and *Scuola Magistrale* (Grade 11). Artistic studies: *Liceo Artistico* (Grade 12); *Instituto d'art* (Grade 12); and *Scuola d'art* (Grade 11). Vocational studies: *Instituto Professionale* (Grade 11). Technical studies: *Instituti Technici* (Grade 13).

Students Tested in Advanced Mathematics and Physics

Advanced Mathematics: students in their final year of *Liceo Scientifico* (classical schools), Grade 11, 12, or 13, depending on the student's program of study, and *Instituti Technici* (technical schools), Grade 13.

Physics: students in their final year of *Liceo Scientifico* (classical schools), Grade 11, 12, or 13, depending on the student's program of study, and *Instituti Technici* (technical schools), Grade 13.

Coverage and Exclusions

Four geographic regions did not participate. Private schools were excluded.

Sample Design

- Definitions of subpopulations:

  MO Students in *Instituti Technici* taking advanced mathematics but not physics

  OP Students in *Instituti Technici* taking physics but not advanced mathematics

MP Students in *Instituti Technici* and *Liceo Scientifico* taking advanced mathematics and physics

OO All other students

- For planning purposes, final-year population was estimated to have 78,000 MP (17% of 462,000 final-year students in *Liceo Scientifici*); 51,000 MO (11% of final-year students) in *Instituti Tecnici*.
- Schools were sampled with probability proportional to school size; 22 Classical (non-science) schools, 6 Art schools, 64 Technical schools; 25 Classical Scientific schools, and 33 Vocational schools were sampled. In each school, one classroom was selected from the final year.

LATVIA

Structure of Upper Secondary System

After basic education, Latvian students may attend secondary school (Grades 10 to 12), where they enter a three-year academic program to prepare for further studies in higher education or enter a vocational school for two to four years. In the academic secondary program, compulsory subjects include Latvian language and literature, mathematics, a foreign language, world history, Latvian history, and physical education. Optional subjects include the study of a second foreign language, economics, geography, computer science, physics, chemistry, biology, music, nature and society, and others. Vocational schools prepare students for independent technical work in various fields and include technical schools, medical schools, agricultural schools, teacher-training schools, and art schools. Vocational schools include instruction in theory and practice in the vocation of choice and some general education instruction.

Students Tested in Mathematics and Science Literacy

Latvia did not test students in mathematics and science literacy.

Students Tested in Advanced Mathematics and Physics

Advanced Mathematics: Latvia did not test students in advanced mathematics.

Physics: students in Grade 12, enrolled in physics courses, in Latvian-speaking academic secondary schools.

Coverage and Exclusions

Latvia tested only physics students in academic secondary schools. Only Latvian-speaking students were included.

Sample Design

- Definitions of subpopulations:

  Subpopulations were not defined; Latvia tested only students taking advanced physics (500 lessons in 3 years) or ordinary physics (300 lessons in 3 years)

- 50 schools offering Advanced Physics were sampled. All students taking Advanced Physics plus one class of Ordinary Physics were sampled.

LITHUANIA

Structure of Upper Secondary System

Upper secondary education in Lithuania includes four-year gymnasia, three-year secondary schools, and two-, three-, or four-year programs in vocational schools. The gymnasium is a four-year educational institution which offers general education at a more advanced level than that in the secondary schools. Traditionally, gymnasia are split into two programs: (1) humanities and (2) mathematics and science. Vocational schools provide general secondary education and training in a profession. There are also "youth schools" for students in basic or secondary school who are, for social reasons, unable to attend general schools. The youth schools provide a one- or two-year program after which students may reenter either the general or vocational schools.

Students Tested in Mathematics and Science Literacy

Lithuania tested students in Grade 12 in vocational, gymnasia, and secondary schools where Lithuanian is the language of instruction.

Students Tested in Advanced Mathematics and Physics

Advanced Mathematics: students in their final year, Grade 12, of the mathematics and science gymnasia and students in secondary schools offering enhanced curriculum in mathematics.

Physics: Lithuania did not test students in physics.

Coverage and Exclusions

Schools not under the authority of the Ministry of Education or the Ministry of Science were excluded. Only Lithuanian-speaking students were tested.

Sample Design

- Definitions of subpopulations:

  MO Students taking optional Math 5 and students taking advanced mathematics in specialized schools

  OO All other students

  Subpopulations were not defined further; Lithuania tested only in Advanced Mathematics and Mathematics and Science Literacy

- Used the same school sample as TIMSS Population 2, plus a supplementary sample of 44 vocational schools and all students taking advanced mathematics in specialized schools.

NETHERLANDS

Structure of Upper Secondary System

Secondary education in the Netherlands is four to six years in duration. Students may follow one of four main tracks: pre-university education (VWO); senior general secondary education (HAVO); junior general secondary education (MAVO); or junior secondary vocational education (VBO).

VWO is a six-year program that leads to university or colleges of higher professional education. HAVO is a five-year program designed to prepare students for higher professional education. MAVO is a four-year program after which students may go on to the fourth year of HAVO, take a short or long senior secondary vocational education course (KMBO or MBO), join an apprenticeship course (LLW), or enter the labor market. VBO is a four-year course of prevocational education specializing in technical, home economics, commercial, trade, and agricultural studies. This can lead to a KMBO or MBO course, an apprenticeship course (LLW), or the labor market. As of 1993, a common core curriculum is taught in the first three grades of VBO, MAVO, HAVO, and VWO. The core curriculum includes 15 subjects, among which are mathematics, combined physics and chemistry, biology, and geography (including earth science). This was the structure of the Netherlands' education system at the time of testing (1995). As of August 1997, the MBO, KMBO, and LLW programs are designated as Senior Vocational Education, offering short and long courses on a full-time or part-time basis.

Students Tested in Mathematics and Science Literacy

The Netherlands tested students in the final year, Grade 12, of the six-year VWO (pre-university) program, students in the final year, Grade 11, of the five-year HAVO (senior general secondary) program, and students in the second year, Grade 12, of a two- to four-year MBO or KMBO (senior secondary vocational) program. These latter students would have completed a four-year MAVO program or a four-year VBO program after primary school before beginning the KMBO or MBO program. Students in the LLW (apprenticeship) programs were excluded.

Students Tested in Advanced Mathematics and Physics

The Netherlands did not test students in advanced mathematics or physics.

Coverage and Exclusions

Students in the LWW (apprenticeships) were excluded.

Sample Design

- Definitions of subpopulations:

  MO Grade 12 students in VWO track taking Math A or Math B but not physics

  OP Grade 12 students in VWO track taking advanced physics but not advanced mathematics

MP Grade 12 students in VWO track taking advanced physics and Math A or Math B

OO All other students

Note: Subpopulations were defined, although the Netherlands only tested students in Mathematics and Science Literacy

- For planning purposes, final-year population was estimated to have 35,000 students in VWO (17% OO, 46% OP, 21% MO, and 16% MP); about 44,000 students in HAVO; and close to 91,000 students in MBO students (all OO)
- Schools were sampled from track-specific frames with probability proportional to school size. Within selected schools, lists of classes were compiled and one classroom was selected at random from the available tracks.

NEW ZEALAND

Structure of Upper Secondary System

Secondary education in New Zealand is offered in comprehensive schools from Grades 8 to 12 (Years 9 to 13). At the lower secondary level, students are required to take a number of compulsory subjects in combination with some optional subjects. The diversity of subjects from which students may choose increases in Grades 11 and 12 (Years 12 and 13). Senior students may also be studying subjects at both senior class levels. For example, a student in Grade 12 may take all Grade 12 subjects, or a combination of Grade 11 and Grade 12 subjects.

There are three national awards which students may choose to study for at secondary school, although not all students choose to participate in national examinations. The first, School Certificate, is the national award undertaken by students at the end of their third year of secondary schooling (Grade 10). The second award, Sixth Form Certificate, is undertaken by most students in their fourth year of secondary schooling (Grade 11). Both certificates can be awarded in single subjects, and a candidate may enter in up to six subjects in one year for each award. The third award, University Bursaries/ Entrance Scholarship, is undertaken by the majority of students at the end of Grade 12 (Year 13). Students may elect to sit for examinations in up to five subjects. In addition, students who have completed a five-year course of study are awarded a Higher School Certificate. A student's performance in, for example, School Certificate mathematics and/or science, often determines his/her participation in these national examinations. While participation in national examinations provides an indication of subject choice, it does not, however, include the range of non-assessed courses or school-developed courses undertaken by many students in the senior school.

Students Tested in Mathematics and Science Literacy

New Zealand tested students in Grade 12 and students in Grade 11 who were not returning to school for Grade 12.

Students Tested in Advanced Mathematics and Physics

Students were not tested in advanced mathematics or physics.

Sample Design

- Definitions of subpopulations:

  Subpopulations were not defined: New Zealand tested only for Mathematics and Science Literacy

- For planning purposes, it was estimated that there are 41,000 students in Grade 11 (Form 6, half of whom it was expected would not be returning to school for Grade 12) and 27,000 in Grade 12 (Form 7), for a total target population size of 48,000.

- 79 schools were drawn with probability proportional to school size. Then, 10 Form 6 and 26 Form 7 students were drawn at random from their grade. Form 6 students were asked a screening question to identify who would be coming back the next year (that is, they are not in their final year of secondary school and thus not eligible for testing) and they were eliminated from the estimation procedure.

NORWAY

Structure of Upper Secondary System

Upper secondary education normally covers the 16-19 year age group or the period from the tenth to the twelfth year of education and training, including general and vocational education as well as apprenticeship training.

Under the system for students tested for TIMSS in 1995, general and vocational studies existed side by side in the same school. There were ten areas of study: General (Academic) Studies; Commercial and Clerical Subjects; Physical Education; Craft and Aesthetic Subjects; Home Economics; Technical and Industrial Subjects; Fishing Trade Subjects; Agricultural and Rural Subjects; Maritime Subjects; and Social Studies and Health. The first three areas of study, as well as the music branch within the area of study of Aesthetic Subjects, met the requirements for admission to universities and other higher educational institutions.

This structure was rather complicated, with a varied set of offerings ranging from general schooling to vocational areas of study with special one-, two-, and three-year programs for more than 200 vocational areas.

Beginning in 1994, a simple, comprehensive system for upper secondary school was introduced. All young people between the ages of 16 and 19 have a legal right to three years of upper secondary education, qualifying them for an occupation and/or higher education.

The following three-year programs of study are offered: General and Business Studies; Music, Drama, and Dance Studies; Sports and Physical Education (all three studies qualifying for higher education); Health and Social Studies; Arts, Crafts, and Design Studies; Agriculture, Fishing, and Forestry Studies; Hotel, Cooking, Waiting, and Food Processing Trades; Building and Construction Trades; Service and Technical Building Trades; Electrical Trades; Engineering and Mechanical Trades; Chemical and Processing Trades; Carpentry. (The last ten programs normally qualify students for an occupation.) It has now become much easier for those with a vocational occupation to meet the requirements for entry to higher education. The number of courses in the second and third years are significantly reduced in the new reform.

Students Tested in Mathematics and Science Literacy

Norway tested students in Grade 12 within all areas of study.

Students Tested in Advanced Mathematics and Physics

Advanced Mathematics: Norway did not test students in advanced mathematics.

Physics: students in their final year, Grade 12, of the three-year physics course in the General (Academic) Studies area. The three-year course in physics includes a foundation course in general science and two physics courses, normally taken in the second and third year.

Coverage and Exclusions

Sample Design

- Definitions of subpopulations:

  MO Not defined

  OP Grade 12 students in general (academic) program taking three-year (3FY) physics course

  MP Not defined

  OO All other students

- For planning purposes, final-year population was estimated to have 27,500 students in General (academic) studies (68% OO; 15%MO; 1%OP; 16%MP), 9300 students in HK branch (100% OO), 8800 in HI branch (100% OO), and 5800 HS and other branches (100% OO).

- A first probability proportional to school size sample of 80 schools offering three-year physics course was drawn and a three-year physics classroom was selected at random; three physics test booklets and two literacy test booklets were rotated. A second (independent) sample of 60 schools was drawn from the complete list of schools and a class of language arts was selected for the mathematics and science literacy assessment. Duplicate students (if any) were identified and excluded from a second testing.

RUSSIAN FEDERATION

Structure of Upper Secondary System

The upper secondary education system in the Russian Federation is a two- to four-year program following compulsory education. Students in upper secondary school join either the general secondary program (usually two years) or vocational program (two to four years). General secondary includes general schools, schools specializing in specific disciplines, gymnasia, lycea, boarding schools, and schools for children with special needs. There are two possibilities for vocational education: initial vocational education provided in so-called professional-technical schools and secondary vocational education provided in the secondary specialized educational establishments (SSZY, technicums, colleges, etc.). All students in upper secondary education have mathematics and science as compulsory subjects. Graduates from both general secondary and vocational secondary programs may continue their education in universities or other higher educational institutions after passing the entrance examinations.

Students Tested in Mathematics and Science Literacy

The Russian Federation tested students in the final year, Grade 11, of general secondary schools.

Students Tested in Advanced Mathematics and Physics

Advanced Mathematics: students in their final year, Grade 11, in general secondary schools in advanced mathematics courses or advanced mathematics and physics courses.

Physics: students in their final year, Grade 11, in general secondary schools in advanced physics courses or advanced mathematics and physics courses.

Coverage and Exclusions

Vocational schools and non-Russian-speaking students excluded.

Sample Design

- Definitions of subpopulations:

  MO Grade 11 students in general secondary schools in advanced mathematics courses but not in physics courses

  OP Grade 11 students in general secondary schools in physics courses but not in advanced mathematics courses

  MP Grade 11 students in general secondary schools in advanced mathematics and physics courses

  OO All other Grade 11 students in general secondary schools

- For planning purposes, it was estimated that 1,500,000 students graduated in 1993, one-third from the vocational program and two-thirds from general secondary. Of those, about 20% take advanced mathematics or physics.

- A first-stage sample of regions was drawn; then, school frames were set up within each selected region. The sample of schools used for the TIMSS Population 2 assessment was used for the Mathematics and Science Literacy assessment, whenever a selected school included the final-year of secondary school. This sample comprised 165 schools (of the 175 drawn for Population 2). 15 students were selected from the final year. A supplementary probability-proportional-to-size (PPS) sample of 132 schools offering advanced physics and advanced mathematics was selected for the Advanced Mathematics and Physics testing. Local lists of student categorization were compiled (excluding OO students covered by first sample) and up to 15 students were drawn from each list.

SLOVENIA

Structure of Upper Secondary System

There are three types of secondary schools in Slovenia: the four-year gymnasium, the four-year technical and professional school, and the two- or three-year vocational school. Students may write an entrance examination to enter tertiary education after completing any four-year upper secondary school. Gymnasia are in principle comprehensive, but some offer a science-heavy curriculum while others emphasize humanities and languages. All students must study mathematics, physics, chemistry, biology, two foreign languages, and a social sciences program of psychology, sociology, and philosophy. As of 1995, students sit for a five-subject externally assessed baccalaureate examination to enter university. The examination includes Slovenian, mathematics, a foreign language, and two subjects chosen by the student. The technical and professional baccalaureate features the same required subjects as the gymnasia, but students choose from economics, electronics, engineering, or similar subjects for the final two sessions. Vocational schools offer programs from two to four years in duration, and usually involve practical work experience as well as classroom time. All vocational schools end with a final examination that may differ from school to school.

Students Tested in Mathematics and Science Literacy

Students in Grade 12 in gymnasia and in technical secondary schools, as well as students in Grade 11 in vocational schools were tested.

Students Tested in Advanced Mathematics and Physics

Advanced Mathematics: students in their final year of gymnasia and technical and professional schools, Grade 12, were tested (all take advanced mathematics).

Physics: students in their final year of gymnasia, Grade 12, taking the physics matura exam were tested.

Coverage and Exclusions

Two-year vocational schools were excluded.

Sample Design

- Definitions of subpopulations:

  MO Grade 12 gymnasium students not taking physics (all take advanced mathematics)

  OP Not applicable

  MP Grade 12 gymnasium students taking physics

  OO Grade 12 students in vocational and technical schools

- For planning purposes, it was estimated that there were 11,300 final-year gymnasium students (9,100 MO and 2,200 MP) and 14,000 final-year vocational and technical students (all OO).

- Original plan was to select 70 gymnasia and 50 technical schools with probability proportional to school size. One class would be drawn at random from the technical schools and 15 MO and 15 MP students would be drawn from the list of grade 12 gymnasium students. Low response rates required that all schools be contacted.

SOUTH AFRICA

Structure of Upper Secondary System

Senior secondary school in South Africa covers Grades 10 to 12. The majority of South African secondary schools are comprehensive. During the first year of senior secondary school (Grade 10), students select six subjects, including the required English and Afrikaans, defining the focus of their studies. Mathematics and science are optional subjects. There are a limited number of schools that provide commercial or technical subjects and a few that provide specialization in the arts. Because of the previous absence of compulsory schooling in South Africa, there is a wide range of entry ages in South African schools, a problem compounded by large numbers of students repeating classes and high drop-out rates.

Students Tested in Mathematics and Science Literacy

Students in Grade 12 were tested in South Africa.

Students Tested in Advanced Mathematics and Physics

South Africa did not test students in advanced mathematics or physics.

Sample Design

- Definitions of subpopulations:

  No subpopulations were defined: South Africa only tested in Mathematics and Science Literacy

- For planning purposes, it was estimated that there were 450,000 students enrolled in Grade 12.

- Schools were stratified by province and sampled within province. Schools in the TIMSS Population 2 (grades 7 and 8) sample were included whenever such schools had students in the final year of secondary school. Supplementary samples were drawn from the provinces of Eastern Cape and North West. The combined samples from Population 2 and the supplements of Eastern Cape and North West comprised 185 schools; of those, 140 offered Grade 12. In many instances, exact measures of size were not known, or were not recorded at the time of data collection. Approximate (provincial averages) sizes had to be used for those undocumented schools.

SWEDEN

Structure of Upper Secondary System

Since 1970, upper secondary school was divided into 47 different lines (*linjer*) and some 400 specialized courses (*specialkurser*). The duration of the lines was two or three years (2-*åriga linjer* and 3-*åriga linjer*, respectively). Thirty-six of the lines were practical/vocational, and 30 of these were of two years duration. Out of the 11 lines for students preparing for university, 5 were of two years duration. The lines were further divided into branches or variants. A new system of upper secondary education was implemented in the early 1990s and was fully up and running by 1996. The new upper secondary system in Sweden is organized into 16 national study programs of three years duration. Students may also follow a specially designed program or an individual program. All 16 national tracks enable students to attend university, although two tracks, Natural Science and Social Science, are specially-geared towards preparing students for university. All programs include eight core subjects: Swedish, English, civics, religious education, mathematics, general science, physical and health education, and arts activities. At the time of TIMSS testing, some schools were still on the former system where students were in upper secondary for two years, while other schools had switched to the new system of a three-year course.

Students Tested in Mathematics and Science Literacy

In schools where the new three-year upper secondary system was implemented, students in Grade 12 were tested. In schools with the former two- or three-year system, students in the final year, Grade 11 or 12, respectively, were tested.

Students Tested in Advanced Mathematics and Physics

Advanced Mathematics: students in the final year, Grade 12, of the Natural Science or Technology lines.

Physics: students in the final year, Grade 12, of the Natural Science or Technology lines.

Sample Design

- Definitions of subpopulations:

  MO Not applicable

  OP Not applicable

  MP Grade 12 students in Natural Science or Technology line

  OO All other students

- For planning purposes, it was estimated that there were 98,000 students enrolled in the final year, with 16,600 OO (17%) and 81,340 MP (83%).

- To obtain reasonable measures of size, some pseudo-schools were formed by joining the smallest schools.
- 150 schools sampled with probability proportional to school size from a complete list of schools. This translated into 157 schools including the schools making up the pseudo-schools. In each sampled school, one class of MP students was drawn at random and a systematic sample of 20 OO students was also drawn.

SWITZERLAND

Structure of Upper Secondary System

Upper secondary education in Switzerland is divided into four major types that last between two to five years, depending on the type and canton. The four types are: *Maturitätsschule* (gymnasium); general education; vocational training; and teacher training. Each major track is differentiated into a number of tracks with narrower definitions. The *Maturitätsschule* is designed to prepare students for university entrance. Typically, students enter at age 15/16, for a total of four years. The school leaving certificate gives them access to higher education. There are five types of *Maturitätsschule*: Type A (emphasis on Greek and Latin); Type B (Latin and modern languages); Type C (mathematics and science); Type D (modern languages); and Type E (economics). *Maturitätsschulen* are governed by federal regulation. The final grade in this type of school could be Grade 12, 12.5, or 13, depending on the canton.

General education schools provide general education to prepare students for certain non-university professions (such as paramedical and social fields). These programs are two or three years in duration and comprise about 3 percent of the in-school population. The upper secondary teacher training program is a five-year program that begins after compulsory education and can lead to university studies.

Vocational training is mostly in the form of apprenticeship, consisting of two basic elements: practical training on the job in an enterprise (3.5 to 4 days per week), and theoretical and general instruction in a vocational school (1 to 1.5 days per week). Vocational training is regulated by federal law and provides recognized apprenticeships of two to four years duration in approximately 280 vocations in the industrial, handicraft, and service sectors. Some students do go on to specialized tertiary institutes in the corresponding vocational field. The final year of vocational training varies by occupation.

Students Tested in Mathematics and Science Literacy

Students in their final year of gymnasium, general education, teacher training, and vocational training were tested. This corresponded to Grade 11 or 12 in gymnasium (final year depends on the canton); Grade 12 in the general track; Grade 12 in the teacher-training track; and Grade 11, 12, or 13 in vocational track (final year varies by occupation).

Students Tested in Advanced Mathematics and Physics

Advanced Mathematics: students in their final year, Grade 12 or 13, of *Maturitätsschule* (gymnasium), in schools and programs (A-E) with federal recognition.

Physics: students in their final year, Grade 12 or 13, of *Maturitätsschule* (gymnasium), in schools and programs (A-E) with federal recognition.

Coverage and Exclusions

Montessori schools and special needs students.

Sample Design

- Definitions of subpopulations:

  MO Not applicable

  OP Not applicable

  MP Students in last year of scientific track of academic schools taking 7 lessons of mathematics and at least 3 lessons of physics per week or students in the last year of other tracks in academic schools taking 4 lessons of mathematics and 2 of physics.

  OO All other students

- For planning purposes, it was estimated that there were 3,300 students (20% MP) in the scientific track and 8,000 students (about 2% MP) in other academic tracks. Total enrollment was estimated to be 71,800.

- Schools were sampled from region-by-track specific frames with probability proportional to school size. Within selected schools, lists of classes were established and one classroom was selected at random. Some schools were included with certainty.

UNITED STATES

Structure of Upper Secondary System

Secondary education in the United States is comprehensive and lasts from Grade 9 to 12 or 10 to 12. Students attend high schools that offer a wide variety of courses. Each student chooses or is guided in the selection of an individually unique set of courses based on their personal interests, future aspirations, or ability. Students who choose a higher proportion of courses which prepare them for university study are generally said to be in a college preparatory or "academic" school program. Those who choose a higher proportion of vocational courses are in a vocational/technical or "vocational" school program. Those whose choice of courses combines general academic and vocational coursework are in general academic or "general" school programs.

Students Tested in Mathematics and Science Literacy

Students in Grade 12 were tested in the United States.

Students Tested in Advanced Mathematics and Physics

Advanced Mathematics: students in Grade 12 who had taken Advanced Placement Calculus, Calculus, or Pre-Calculus.

Physics: students in Grade 12 who had taken Advanced Placement Physics or Physics.

Coverage and Exclusions

Sample Design

- Definitions of subpopulations:

  MO Students having taken Advanced Placement Calculus, Calculus, or Pre-Calculus during grades 9 - 12 but not physics

  OP Students having taken Advanced Placement Physics or Physics during grades 9 - 12 but not advanced mathematics

  MP Students having taken Advanced Placement Calculus, Calculus, or Pre-Calculus and Advanced Placement Physics or Physics during grades 9 - 12

  OO Students not having taken Advanced Placement Calculus, Calculus, or Pre-Calculus, or Advanced Placement Physics or Physics during grades 9 - 12

- Target population was 72.9% OO; 9.0% OP; 6.7% MO; and 11.3% MP

- A three-stage stratified design was used. Geographic regions were the primary sampling units: 48 non-certainty and 11 certainty primary sampling units were drawn for the first-stage sample. Then, 250 schools were selected with probability proportional to school size from stratified lists within the selected primary sampling units. Finally, students were selected from school-level subpopulation lists.

Appendix C: Sampling and Imputation Standard Errors by Gender Tables

C

Table C.1 Sampling and Imputation Standard Errors
Mathematics and Science Literacy Scale
Males in Their Final Year of Secondary School

Country	Sample Size	Population Size	Mean of 5 Plausible Values	Error Due to Sampling	Error Due to Imputation	Sampling and Imputation Error	S.D.	S.E. of the S.D.
Australia	775	71070	543	10.7	1.2	10.7	99.8	5.8
Austria	878	26595	549	7.7	1.4	7.8	84.9	4.5
Canada	2672	122763	544	3.3	0.8	3.4	84.0	2.2
Cyprus	251	2045	456	4.6	1.8	4.9	78.0	3.9
Czech Republic	1115	70435	500	9.9	0.9	9.9	92.9	3.5
Denmark	1206	16777	554	4.3	1.0	4.5	80.0	3.0
France	813	298449	526	5.8	1.2	5.9	75.1	3.6
Germany	1071	523599	512	7.9	2.1	8.2	85.6	4.0
Hungary	2370	56115	485	4.4	0.8	4.5	90.6	3.0
Iceland	800	1085	565	2.7	0.9	2.9	76.5	2.0
Italy	776	174400	492	6.8	1.0	6.9	85.6	4.8
Lithuania	948	7657	483	6.7	0.5	6.7	75.8	3.3
Netherlands	745	75222	584	5.4	0.8	5.5	78.1	4.2
New Zealand	852	18434	540	5.5	1.6	5.7	96.6	3.3
Norway	1190	22142	564	5.0	0.7	5.0	89.1	3.1
Russian Federation	841	392477	499	5.7	1.5	5.9	81.0	3.3
Slovenia	828	13336	538	12.5	1.1	12.6	84.1	8.3
South Africa	1315	178372	366	10.3	0.6	10.3	87.8	8.4
Sweden	1462	34787	579	5.8	1.2	5.9	96.0	2.8
Switzerland	1660	36160	547	5.9	1.2	6.0	86.7	3.4
United States	2839	1133206	479	4.1	0.9	4.2	92.6	2.4

S.D. = standard deviation
S.E. = standard error

Table C.2 Sampling and Imputation Standard Errors Mathematics and Science Literacy Scale Females in Their Final Year of Secondary School

Country	Sample Size	Population Size	Mean of 5 Plausible Values	Error Due to Sampling	Error Due to Imputation	Sampling and Imputation Error	S.D.	S.E. of the S.D.
Australia	1166	99777	511	9.3	0.2	9.3	88.8	5.4
Austria	1041	42428	502	5.4	1.0	5.5	71.3	3.2
Canada	2533	137972	511	3.2	1.0	3.4	79.3	1.9
Cyprus	280	2491	439	2.9	0.8	3.0	67.3	2.9
Czech Republic	1052	67024	452	13.7	1.0	13.8	83.8	3.7
Denmark	1446	20329	507	3.6	0.8	3.7	75.8	2.5
France	759	331891	487	4.7	1.1	4.8	68.0	2.6
Germany	1108	416372	479	8.4	1.5	8.5	88.9	4.6
Hungary	2542	51285	468	4.4	0.6	4.5	76.1	2.3
Iceland	887	1199	522	1.8	0.7	1.9	71.9	1.3
Italy	840	206434	461	5.7	0.6	5.7	78.3	5.0
Lithuania	1938	14489	456	7.4	0.5	7.4	81.3	3.5
Netherlands	725	70694	533	5.7	1.3	5.9	82.4	4.7
New Zealand	911	19115	511	5.4	1.1	5.5	85.0	3.1
Norway	1328	21664	507	4.5	0.4	4.5	76.2	2.6
Russian Federation	1448	638710	462	6.5	0.7	6.5	81.2	3.6
Slovenia	735	12601	492	7.1	0.5	7.1	72.6	3.8
South Africa	1370	187962	341	11.8	0.9	11.8	87.1	13.6
Sweden	1606	36457	533	3.6	0.3	3.6	80.3	2.2
Switzerland	1623	28240	511	7.4	1.4	7.5	84.7	2.9
United States	2968	1145052	462	3.5	0.2	3.5	84.7	3.0

S.D. = standard deviation
S.E. = standard error

Table C.3 Sampling and Imputation Standard Errors - Mathematic Literacy Scale Males in Their Final Year of Secondary School

Country	Sample Size	Population Size	Mean of 5 Plausible Values	Error Due to Sampling	Error Due to Imputation	Sampling and Imputation Error	S.D.	S.E. of the S.D.
Australia	775	71070	540	10.3	0.5	10.3	102.8	6.1
Austria	878	26595	545	7.1	1.2	7.2	82.2	4.1
Canada	2672	122763	537	3.7	1.1	3.8	90.7	2.7
Cyprus	251	2045	454	4.5	1.8	4.9	77.8	4.0
Czech Republic	1115	70435	488	11.2	1.1	11.3	101.3	4.0
Denmark	1206	16777	575	3.9	0.8	4.0	83.8	3.8
France	813	298449	544	5.6	1.0	5.6	79.1	3.6
Germany	1071	523599	509	8.3	2.8	8.7	91.0	4.4
Hungary	2370	56115	485	4.8	0.9	4.9	98.9	3.0
Iceland	800	1085	558	3.4	0.6	3.4	86.5	2.4
Italy	776	174400	490	7.2	1.5	7.4	89.6	5.0
Lithuania	948	7657	485	7.3	0.7	7.3	80.3	4.2
Netherlands	745	75222	585	5.5	1.0	5.6	81.6	3.8
New Zealand	852	18434	536	4.5	1.8	4.9	100.9	3.0
Norway	1190	22142	555	5.2	0.9	5.3	95.0	2.9
Russian Federation	841	392477	488	6.4	1.2	6.5	85.6	3.5
Slovenia	828	13336	535	12.6	1.1	12.7	87.2	8.9
South Africa	1315	178372	365	9.3	0.9	9.3	83.3	8.2
Sweden	1462	34787	573	5.9	1.0	5.9	103.2	3.0
Switzerland	1660	36160	555	6.3	1.2	6.4	87.9	3.6
United States	2839	1133206	466	4.0	0.8	4.1	94.2	2.6

S.D. = standard deviation
S.E. = standard error

Table C.4 Sampling and Imputation Standard Errors - Mathematic Literacy Scale Females in Their Final Year of Secondary School

Country	Sample Size	Population Size	Mean of 5 Plausible Values	Error Due to Sampling	Error Due to Imputation	Sampling and Imputation Error	S.D.	S.E. of the S.D.
Australia	1166	99777	510	9.3	0.7	9.3	90.9	5.1
Austria	1041	42428	503	5.4	1.4	5.5	73.5	2.9
Canada	2533	137972	504	3.3	1.2	3.5	86.7	2.6
Cyprus	280	2491	439	3.5	1.0	3.7	67.6	2.9
Czech Republic	1052	67024	443	16.7	1.9	16.8	91.8	3.6
Denmark	1446	20329	523	3.9	0.9	4.0	81.9	2.6
France	759	331891	506	5.1	1.3	5.3	74.9	2.8
Germany	1108	416372	480	8.7	1.6	8.8	93.9	4.5
Hungary	2542	51285	481	4.8	0.6	4.8	84.6	2.3
Iceland	887	1199	514	2.1	0.7	2.2	83.5	1.2
Italy	840	206434	464	5.9	1.0	6.0	83.7	5.2
Lithuania	1938	14489	461	7.7	0.8	7.7	85.8	3.6
Netherlands	725	70694	533	5.8	1.3	5.9	90.4	4.4
New Zealand	911	19115	507	6.0	1.6	6.2	93.2	3.0
Norway	1328	21664	501	4.8	0.3	4.8	84.5	2.5
Russian Federation	1448	638710	460	6.5	1.2	6.6	83.7	3.9
Slovenia	735	12601	490	8.0	0.5	8.0	79.4	4.6
South Africa	1370	187962	348	10.7	1.0	10.8	79.9	13.3
Sweden	1606	36457	531	3.8	0.4	3.9	89.4	2.4
Switzerland	1623	28240	522	7.2	1.4	7.4	85.9	2.9
United States	2968	1145052	456	3.5	0.7	3.6	87.6	2.6

S.D. = standard deviation
S.E. = standard error

Table C.5 Sampling and Imputation Standard Errors - Science Literacy Scale Males in Their Final Year of Secondary School

Country	Sample Size	Population Size	Mean of 5 Plausible Values	Error Due to Sampling	Error Due to Imputation	Sampling and Imputation Error	S.D.	S.E. of the S.D.
Australia	775	71070	547	11.3	2.1	11.5	103.8	5.6
Austria	878	26595	554	8.5	1.8	8.7	93.6	5.0
Canada	2672	122763	550	3.4	1.3	3.6	86.1	2.2
Cyprus	251	2045	459	5.4	2.1	5.8	88.5	4.6
Czech Republic	1115	70435	512	8.8	0.7	8.8	91.2	3.2
Denmark	1206	16777	532	5.2	1.4	5.4	87.1	3.3
France	813	298449	508	6.4	2.0	6.7	81.1	3.4
Germany	1071	523599	514	7.7	1.6	7.9	86.8	3.9
Hungary	2370	56115	484	4.1	0.8	4.2	91.1	3.0
Iceland	800	1085	572	2.4	1.2	2.7	75.5	1.9
Italy	776	174400	495	6.6	1.2	6.7	88.5	4.9
Lithuania	948	7657	481	6.4	0.5	6.4	79.3	2.9
Netherlands	745	75222	582	5.6	1.3	5.7	81.9	4.9
New Zealand	852	18434	543	6.8	1.9	7.1	100.0	4.7
Norway	1190	22142	574	5.0	0.9	5.1	92.7	3.6
Russian Federation	841	392477	510	5.4	1.9	5.7	86.2	3.7
Slovenia	828	13336	541	12.7	1.1	12.7	87.2	7.8
South Africa	1315	178372	367	11.4	1.0	11.5	98.2	8.5
Sweden	1462	34787	585	5.8	1.4	6.0	95.4	2.8
Switzerland	1660	36160	540	5.9	1.4	6.1	92.5	3.3
United States	2839	1133206	492	4.4	1.1	4.5	97.6	2.7

S.D. = standard deviation
S.E. = standard error

Table C.6 Sampling and Imputation Standard Errors - Science Literacy Scale Females in Their Final Year of Secondary School

Country	Sample Size	Population Size	Mean of 5 Plausible Values	Error Due to Sampling	Error Due to Imputation	Sampling and Imputation Error	S.D.	S.E. of the S.D.
Australia	1166	99777	513	9.4	0.6	9.4	93.9	5.9
Austria	1041	42428	501	5.6	1.4	5.8	75.5	3.4
Canada	2533	137972	518	3.7	0.9	3.8	80.3	2.2
Cyprus	280	2491	439	3.0	0.6	3.0	76.4	3.6
Czech Republic	1052	67024	460	10.9	0.7	11.0	83.5	3.6
Denmark	1446	20329	490	4.0	1.0	4.1	82.1	2.8
France	759	331891	468	4.7	1.0	4.8	71.4	2.4
Germany	1108	416372	478	8.4	1.4	8.5	90.7	4.7
Hungary	2542	51285	455	4.2	0.8	4.3	77.9	2.3
Iceland	887	1199	530	1.9	0.8	2.1	68.8	1.8
Italy	840	206434	458	5.6	0.4	5.6	81.5	4.6
Lithuania	1938	14489	450	7.3	0.5	7.3	84.4	3.6
Netherlands	725	70694	532	6.0	1.6	6.2	82.0	5.2
New Zealand	911	19115	515	5.1	0.7	5.2	86.5	3.8
Norway	1328	21664	513	4.5	0.5	4.5	78.7	2.7
Russian Federation	1448	638710	463	6.6	1.0	6.7	89.0	3.2
Slovenia	735	12601	494	6.3	1.0	6.4	71.9	3.4
South Africa	1370	187962	333	12.9	1.5	13.0	99.9	13.5
Sweden	1606	36457	534	3.4	0.5	3.5	79.1	2.2
Switzerland	1623	28240	500	7.7	1.6	7.8	90.4	3.4
United States	2968	1145052	469	3.8	0.7	3.9	88.6	3.5

S.D. = standard deviation
S.E. = standard error

Table C.7 Sampling and Imputation Standard Errors - Advanced Mathematics Scale Males in Their Final Year of Secondary School

Country	Sample Size	Population Size	Mean of 5 Plausible Values	Error Due to Sampling	Error Due to Imputation	Sampling and Imputation Error	S.D.	S.E. of the S.D.
Australia	360	21889	531	11.1	2.2	11.4	107.7	9.0
Austria	299	11492	486	6.9	2.1	7.3	76.1	5.4
Canada	1474	30953	528	6.2	1.5	6.4	102.7	2.9
Cyprus	237	509	524	4.2	1.4	4.4	90.4	3.9
Czech Republic	451	7877	524	12.9	1.0	13.0	106.2	12.0
Denmark	853	8193	529	4.2	1.3	4.4	76.0	2.3
France	665	93959	567	4.9	1.5	5.1	69.8	2.6
Germany	832	109689	484	6.4	0.7	6.5	86.2	4.1
Greece	316	10121	516	6.5	1.1	6.6	111.2	7.5
Italy	258	63223	484	10.6	0.8	10.6	94.2	8.7
Lithuania	372	691	542	3.4	1.5	3.7	84.1	3.8
Russian Federation	908	22259	568	9.7	1.1	9.7	110.6	4.4
Slovenia	746	11199	484	11.5	0.9	11.5	96.9	5.4
Sweden	644	11309	519	5.7	1.8	5.9	88.2	3.6
Switzerland	766	6002	559	5.1	2.4	5.6	93.3	3.9
United States	1417	254188	457	7.6	1.9	7.8	95.9	4.8

S.D. = standard deviation
S.E. = standard error

Table C.8 Sampling and Imputation Standard Errors - Advanced Mathematics Scale Females in Their Final Year of Secondary School

Country	Sample Size	Population Size	Mean of 5 Plausible Values	Error Due to Sampling	Error Due to Imputation	Sampling and Imputation Error	S.D.	S.E. of the S.D.
Australia	285	17609	517	14.7	3.4	15.1	110.4	9.3
Austria	464	18837	406	8.6	0.7	8.6	86.7	6.6
Canada	1298	27551	489	4.3	0.8	4.4	88.9	2.7
Cyprus	151	322	509	6.0	2.3	6.4	76.6	4.9
Czech Republic	650	11569	432	8.6	2.1	8.9	88.6	6.4
Denmark	479	4860	510	4.5	1.1	4.6	67.6	3.4
France	390	55043	543	5.0	0.9	5.1	67.2	2.9
Germany	1418	147800	452	6.5	1.0	6.6	81.2	3.9
Greece	138	4455	505	9.6	3.5	10.2	88.0	8.5
Italy	140	41254	460	14.0	1.8	14.1	94.9	13.1
Lithuania	362	669	490	5.5	0.8	5.6	78.0	6.8
Russian Federation	730	20599	515	10.1	1.5	10.2	106.0	8.0
Slovenia	775	11340	464	10.9	1.3	11.0	89.1	3.5
Sweden	357	5099	496	4.5	2.7	5.2	77.6	4.5
Switzerland	623	5216	503	5.4	1.5	5.7	76.6	4.9
United States	1368	242664	426	6.9	1.7	7.1	97.6	5.6

S.D. = standard deviation
S.E. = standard error

Table C.9 Sampling and Imputation Standard Errors - Numbers and Equations Males in Their Final Year of Secondary School

Country	Sample Size	Population Size	Mean of 5 Plausible Values	Error Due to Sampling	Error Due to Imputation	Sampling and Imputation Error	S.D.	S.E. of the S.D.
Australia	360	21889	523	9.7	1.5	9.9	98.4	9.1
Austria	299	11492	455	5.9	1.7	6.2	77.1	5.1
Canada	1474	30953	526	5.4	1.5	5.6	88.3	2.7
Cyprus	237	509	518	6.4	1.2	6.5	97.5	3.4
Czech Republic	451	7877	510	11.1	1.7	11.3	99.0	7.6
Denmark	853	8193	507	3.5	0.9	3.6	63.9	2.2
France	665	93959	551	5.3	1.0	5.4	58.6	3.3
Germany	832	109689	475	6.0	1.6	6.2	79.9	4.4
Greece	316	10121	540	8.7	2.6	9.1	121.4	9.9
Italy	258	63223	472	10.6	0.5	10.6	100.9	8.8
Lithuania	372	691	568	2.8	1.0	3.0	82.7	4.8
Russian Federation	908	22259	576	9.5	1.8	9.6	104.1	3.8
Slovenia	746	11199	503	12.9	1.6	13.0	111.8	7.6
Sweden	644	11309	529	6.2	1.3	6.4	91.4	3.9
Switzerland	766	6002	536	5.4	1.9	5.7	92.5	4.6
United States	1417	254188	470	5.8	1.9	6.1	84.8	4.0

S.D. = standard deviation
S.E. = standard error

Table C.10 Sampling and Imputation Standard Errors - Numbers and Equations Females in Their Final Year of Secondary School

Country	Sample Size	Population Size	Mean of 5 Plausible Values	Error Due to Sampling	Error Due to Imputation	Sampling and Imputation Error	S.D.	S.E. of the S.D.
Australia	285	17609	511	10.8	3.0	11.2	97.1	8.2
Austria	464	18837	385	9.2	1.1	9.3	89.6	6.9
Canada	1298	27551	496	4.2	1.6	4.5	76.5	3.6
Cyprus	151	322	497	6.4	2.8	7.0	83.3	5.2
Czech Republic	650	11569	427	10.4	1.6	10.5	92.6	7.1
Denmark	479	4860	498	3.2	1.3	3.5	59.3	3.1
France	390	55043	544	3.7	1.0	3.9	51.8	3.1
Germany	1418	147800	446	5.1	0.5	5.1	76.4	3.8
Greece	138	4455	537	10.1	2.5	10.4	90.3	7.2
Italy	140	41254	441	14.1	0.5	14.1	103.8	15.0
Lithuania	362	669	526	4.4	3.0	5.4	81.0	3.9
Russian Federation	730	20599	533	9.4	3.1	9.8	105.0	7.6
Slovenia	775	11340	480	10.8	0.8	10.8	97.5	3.5
Sweden	357	5099	511	5.0	2.5	5.6	80.1	5.4
Switzerland	623	5216	488	5.6	1.2	5.7	73.9	5.6
United States	1368	242664	447	6.7	1.8	6.9	87.0	5.5

S.D. = standard deviation
S.E. = standard error

Table C.11 Sampling and Imputation Standard Errors - Calculus Scale Males in Their Final Year of Secondary School

Country	Sample Size	Population Size	Mean of 5 Plausible Values	Error Due to Sampling	Error Due to Imputation	Sampling and Imputation Error	S.D.	S.E. of the S.D.
Australia	360	21889	533	13.6	1.5	13.6	102.5	14.0
Austria	299	11492	486	6.5	2.2	6.9	73.1	7.4
Canada	1474	30953	521	5.4	0.9	5.5	97.2	3.8
Cyprus	237	509	559	4.9	1.0	5.0	101.2	5.2
Czech Republic	451	7877	488	10.9	0.9	11.0	102.0	9.8
Denmark	853	8193	517	4.1	1.0	4.3	87.0	2.9
France	665	93959	569	4.2	0.8	4.3	65.2	2.8
Germany	832	109689	471	5.6	0.8	5.6	87.6	4.4
Greece	316	10121	540	7.8	2.7	8.2	104.4	6.3
Italy	258	63223	520	11.4	0.9	11.4	106.8	8.8
Lithuania	372	691	518	3.9	1.8	4.3	79.4	3.3
Russian Federation	908	22259	560	8.9	0.8	8.9	105.9	5.6
Slovenia	746	11199	479	8.2	0.9	8.2	73.7	3.8
Sweden	644	11309	484	5.8	1.4	6.0	91.8	3.7
Switzerland	766	6002	536	6.3	2.4	6.8	99.2	4.1
United States	1417	254188	460	4.6	2.6	5.3	95.6	4.5

S.D. = standard deviation
S.E. = standard error

Table C.12 Sampling and Imputation Standard Errors - Calculus Scale Females in Their Final Year of Secondary School

Country	Sample Size	Population Size	Mean of 5 Plausible Values	Error Due to Sampling	Error Due to Imputation	Sampling and Imputation Error	S.D.	S.E. of the S.D.
Australia	285	17609	525	11.9	2.7	12.2	97.4	9.4
Austria	464	18837	412	7.3	0.8	7.3	83.4	4.8
Canada	1298	27551	484	4.2	2.6	4.9	83.4	4.2
Cyprus	151	322	562	7.7	2.3	8.0	98.2	4.8
Czech Republic	650	11569	417	8.2	1.6	8.3	82.2	4.7
Denmark	479	4860	491	5.2	1.3	5.4	82.8	3.6
France	390	55043	544	3.9	1.2	4.1	59.3	2.5
Germany	1418	147800	442	5.0	1.1	5.2	81.3	2.9
Greece	138	4455	536	11.3	4.0	12.0	83.0	10.4
Italy	140	41254	521	13.4	0.8	13.5	108.1	7.4
Lithuania	362	669	478	4.4	1.7	4.8	71.2	4.9
Russian Federation	730	20599	512	10.6	2.5	10.9	101.2	9.4
Slovenia	775	11340	463	7.9	0.8	7.9	67.1	2.4
Sweden	357	5099	472	4.5	2.0	4.9	78.0	4.2
Switzerland	623	5216	486	6.1	1.0	6.2	85.7	5.7
United States	1368	242664	439	5.9	1.6	6.1	97.9	6.5

S.D. = standard deviation
S.E. = standard error

Table C.13 Sampling and Imputation Standard Errors - Geometry Scale Males in Their Final Year of Secondary School

Country	Sample Size	Population Size	Mean of 5 Plausible Values	Error Due to Sampling	Error Due to Imputation	Sampling and Imputation Error	S.D.	S.E. of the S.D.
Australia	360	21889	505	14.0	1.5	14.1	122.6	14.1
Austria	299	11492	509	7.5	1.8	7.7	82.1	4.6
Canada	1474	30953	516	4.7	2.4	5.3	97.1	2.8
Cyprus	237	509	520	5.1	1.0	5.2	104.2	5.6
Czech Republic	451	7877	543	12.0	1.4	12.1	105.2	11.8
Denmark	853	8193	531	4.0	1.3	4.2	74.6	2.6
France	665	93959	555	5.3	2.1	5.7	77.3	2.7
Germany	832	109689	498	6.9	1.4	7.0	77.0	4.4
Greece	316	10121	505	7.0	2.8	7.5	119.4	6.3
Italy	258	63223	485	10.4	0.9	10.4	102.5	9.0
Lithuania	372	691	539	3.2	1.7	3.6	82.8	2.9
Russian Federation	908	22259	570	8.8	0.9	8.9	102.8	4.5
Slovenia	746	11199	482	9.5	1.5	9.6	86.0	4.4
Sweden	644	11309	500	5.4	1.1	5.5	85.0	3.4
Switzerland	766	6002	569	3.2	1.9	3.8	86.8	4.3
United States	1417	254188	439	5.4	2.0	5.8	94.2	5.3

S.D. = standard deviation
S.E. = standard error

Table C.14 Sampling and Imputation Standard Errors - Geometry Scale Females in Their Final Year of Secondary School

Country	Sample Size	Population Size	Mean of 5 Plausible Values	Error Due to Sampling	Error Due to Imputation	Sampling and Imputation Error	S.D.	S.E. of the S.D.
Australia	285	17609	485	13.6	2.8	13.8	121.5	8.1
Austria	464	18837	433	9.5	1.3	9.6	95.6	8.3
Canada	1298	27551	482	4.2	2.0	4.6	88.9	2.4
Cyprus	151	322	512	8.1	2.8	8.5	90.8	7.8
Czech Republic	650	11569	461	7.2	0.8	7.2	85.3	5.8
Denmark	479	4860	519	3.6	1.7	4.0	63.9	3.6
France	390	55043	529	4.5	1.6	4.8	71.6	3.6
Germany	1418	147800	480	5.5	0.7	5.6	72.7	4.2
Greece	138	4455	485	14.6	4.8	15.4	102.4	13.6
Italy	140	41254	472	14.5	0.4	14.5	105.1	14.7
Lithuania	362	669	491	4.9	3.1	5.8	74.3	5.6
Russian Federation	730	20599	525	9.9	3.4	10.5	99.2	7.4
Slovenia	775	11340	469	8.9	0.5	8.9	80.0	2.9
Sweden	357	5099	476	4.7	2.0	5.1	75.9	5.5
Switzerland	623	5216	522	5.6	1.8	5.9	80.1	5.9
United States	1368	242664	408	6.8	1.3	7.0	96.1	6.3

S.D. = standard deviation
S.E. = standard error

Table C.15 Sampling and Imputation Standard Errors - Physics Scale Males in Their Final Year of Secondary School

Country	Sample Size	Population Size	Mean of 5 Plausible Values	Error Due to Sampling	Error Due to Imputation	Sampling and Imputation Error	S.D.	S.E. of the S.D.
Australia	417	20973	532	6.5	1.4	6.7	82.3	5.6
Austria	306	11559	479	8.1	0.7	8.1	82.5	5.7
Canada	1440	28901	506	5.0	3.2	6.0	89.7	4.2
Cyprus	230	523	509	8.8	1.0	8.9	107.8	7.9
Czech Republic	426	7460	503	8.7	1.4	8.8	83.1	5.4
Denmark	480	1547	542	4.7	2.3	5.2	86.9	4.4
France	670	90387	478	3.9	1.5	4.2	67.0	4.4
Germany	487	59545	542	14.3	1.5	14.3	92.7	6.9
Greece	311	10015	495	5.9	1.4	6.1	89.7	5.0
Latvia (LSS)	374	495	509	18.9	1.5	19.0	99.5	11.5
Norway	781	3221	594	5.8	2.3	6.3	87.6	2.5
Russian Federation	714	17949	575	9.8	1.5	9.9	102.8	3.8
Slovenia	566	8274	546	16.1	2.1	16.3	99.4	10.8
Sweden	651	11056	589	4.8	1.7	5.1	94.1	3.7
Switzerland	727	5662	529	4.9	1.5	5.2	85.8	4.0
United States	1617	270205	439	4.2	1.1	4.3	61.5	5.0

S.D. = standard deviation
S.E. = standard error

Table C.16 Sampling and Imputation Standard Errors - Physics Scale Females in Their Final Year of Secondary School

Country	Sample Size	Population Size	Mean of 5 Plausible Values	Error Due to Sampling	Error Due to Imputation	Sampling and Imputation Error	S.D.	S.E. of the S.D.
Australia	244	10647	490	7.3	4.2	8.4	74.6	5.3
Austria	457	18721	408	7.3	1.0	7.4	71.5	5.9
Canada	913	22098	459	6.0	1.8	6.3	74.9	3.9
Cyprus	137	311	470	6.9	1.7	7.1	96.0	7.9
Czech Republic	661	11968	419	3.9	0.4	3.9	63.2	5.1
Denmark	117	394	500	6.0	5.4	8.1	73.9	6.8
France	417	57604	450	5.0	2.3	5.6	60.8	3.2
Germany	222	26328	479	9.1	1.1	9.1	80.3	5.3
Greece	148	4652	468	7.9	1.8	8.1	78.6	6.9
Latvia (LSS)	334	484	467	22.6	1.9	22.6	96.6	11.4
Norway	267	1148	544	9.0	2.4	9.3	88.3	4.5
Russian Federation	519	15026	509	14.8	3.8	15.3	108.1	9.1
Slovenia	160	3162	455	18.3	3.9	18.7	105.6	6.4
Sweden	361	5402	540	5.1	1.4	5.3	77.8	4.8
Switzerland	632	5495	446	3.5	0.8	3.6	68.8	2.9
United States	1497	252579	405	2.8	1.4	3.1	53.0	1.8

S.D. = standard deviation
S.E. = standard error

Table C.17 Sampling and Imputation Standard Errors - Mechanics Scale Males in Their Final Year of Secondary School

Country	Sample Size	Population Size	Mean of 5 Plausible Values	Error Due to Sampling	Error Due to Imputation	Sampling and Imputation Error	S.D.	S.E. of the S.D.
Australia	417	20973	524	7.7	1.1	7.8	84.9	6.8
Austria	306	11559	459	6.6	0.9	6.6	74.1	5.4
Canada	1440	28901	499	6.5	1.1	6.6	92.1	4.9
Cyprus	230	523	551	9.6	0.5	9.6	120.1	7.6
Czech Republic	426	7460	514	8.3	1.6	8.4	80.8	6.7
Denmark	480	1547	540	5.5	0.9	5.5	87.9	4.2
France	670	90387	470	5.2	1.9	5.6	76.4	4.5
Germany	487	59545	515	9.5	1.5	9.6	84.2	7.7
Greece	311	10015	525	6.9	1.5	7.0	91.6	5.4
Latvia (LSS)	374	495	509	15.1	1.3	15.2	93.4	13.1
Norway	781	3221	589	5.5	2.6	6.1	84.0	3.5
Russian Federation	714	17949	563	7.4	0.2	7.4	84.3	4.7
Slovenia	566	8274	576	17.4	1.9	17.5	111.3	12.6
Sweden	651	11056	586	4.5	0.6	4.6	76.0	3.1
Switzerland	727	5662	519	5.3	0.6	5.3	82.4	4.5
United States	1617	270205	446	3.2	1.5	3.5	54.1	3.7

S.D. = standard deviation
S.E. = standard error

Table C.18 Sampling and Imputation Standard Errors - Mechanics Scale Females in Their Final Year of Secondary School

Country	Sample Size	Population Size	Mean of 5 Plausible Values	Error Due to Sampling	Error Due to Imputation	Sampling and Imputation Error	S.D.	S.E. of the S.D.
Australia	244	10647	474	6.6	1.6	6.8	83.4	8.8
Austria	457	18721	399	6.2	0.8	6.3	70.3	5.0
Canada	913	22098	440	5.4	1.8	5.7	72.8	3.7
Cyprus	137	311	496	10.3	0.5	10.3	102.5	8.6
Czech Republic	661	11968	440	4.7	1.0	4.8	66.1	5.3
Denmark	117	394	483	9.2	4.3	10.2	80.4	5.4
France	417	57604	437	3.8	3.9	5.5	68.0	4.6
Germany	222	26328	453	10.4	1.8	10.6	88.0	6.8
Greece	148	4652	489	6.7	2.7	7.2	83.6	7.3
Latvia (LSS)	334	484	468	19.6	2.2	19.8	84.5	6.1
Norway	267	1148	523	8.7	2.4	9.0	86.4	6.7
Russian Federation	519	15026	507	12.2	1.1	12.3	90.3	10.5
Slovenia	160	3162	487	21.6	2.4	21.7	122.6	10.4
Sweden	361	5402	517	4.0	1.7	4.4	68.7	4.4
Switzerland	632	5495	444	3.5	0.3	3.5	70.9	2.7
United States	1497	252579	393	2.6	1.0	2.8	51.4	2.0

S.D. = standard deviation
S.E. = standard error

Table C.19 Sampling and Imputation Standard Errors - Electricity and Magnetism Scale Males in Their Final Year of Secondary School

Country	Sample Size	Population Size	Mean of 5 Plausible Values	Error Due to Sampling	Error Due to Imputation	Sampling and Imputation Error	S.D.	S.E. of the S.D.
Australia	417	20973	525	6.6	1.2	6.7	90.5	6.3
Austria	306	11559	468	9.0	1.3	9.1	99.8	6.6
Canada	1440	28901	497	6.0	1.8	6.2	88.3	5.1
Cyprus	230	523	507	8.4	1.1	8.5	118.7	8.2
Czech Republic	426	7460	501	8.5	1.9	8.7	79.5	6.8
Denmark	480	1547	515	4.3	1.2	4.5	84.0	5.6
France	670	90387	495	4.0	1.2	4.2	61.2	3.5
Germany	487	59545	522	11.8	2.6	12.1	93.7	6.3
Greece	311	10015	522	6.2	1.8	6.5	109.6	5.4
Latvia (LSS)	374	495	496	16.6	2.5	16.8	96.9	10.2
Norway	781	3221	570	5.9	2.1	6.2	93.1	3.7
Russian Federation	714	17949	575	7.6	1.1	7.7	101.5	3.5
Slovenia	566	8274	522	16.4	2.1	16.6	107.3	13.1
Sweden	651	11056	579	4.7	1.0	4.8	92.8	3.8
Switzerland	727	5662	507	7.0	1.2	7.1	95.8	4.4
United States	1617	270205	430	3.4	0.8	3.5	59.2	3.4

S.D. = standard deviation
S.E. = standard error

Table C.20 Sampling and Imputation Standard Errors - Electricity and Magnetism Scale Females in Their Final Year of Secondary School

Country	Sample Size	Population Size	Mean of 5 Plausible Values	Error Due to Sampling	Error Due to Imputation	Sampling and Imputation Error	S.D.	S.E. of the S.D.
Australia	244	10647	488	7.8	2.6	8.3	86.9	7.9
Austria	457	18721	409	6.8	1.5	6.9	82.5	4.7
Canada	913	22098	468	6.3	1.6	6.5	73.1	4.5
Cyprus	137	311	494	7.3	1.2	7.4	106.9	9.5
Czech Republic	661	11968	443	3.1	1.1	3.3	62.7	5.0
Denmark	117	394	498	6.9	3.8	7.8	68.9	4.7
France	417	57604	491	4.8	1.9	5.2	57.8	3.8
Germany	222	26328	491	7.4	1.9	7.7	79.3	6.2
Greece	148	4652	515	10.3	3.9	11.0	94.2	8.0
Latvia (LSS)	334	484	474	17.9	3.9	18.4	90.1	6.7
Norway	267	1148	549	9.7	2.4	10.0	90.5	5.9
Russian Federation	519	15026	519	12.5	3.2	12.9	105.7	8.1
Slovenia	160	3162	470	13.7	2.0	13.8	108.4	12.2
Sweden	361	5402	551	4.4	1.7	4.7	74.1	4.8
Switzerland	632	5495	452	4.3	1.4	4.5	83.4	3.8
United States	1497	252579	409	3.5	0.8	3.6	56.0	2.0

S.D. = standard deviation
S.E. = standard error

Table C.21 Sampling and Imputation Standard Errors - Heat Scale Males in Their Final Year of Secondary School

Country	Sample Size	Population Size	Mean of 5 Plausible Values	Error Due to Sampling	Error Due to Imputation	Sampling and Imputation Error	S.D.	S.E. of the S.D.
Australia	417	20973	524	4.9	1.2	5.0	84.1	5.6
Austria	306	11559	485	7.9	1.2	8.0	92.0	7.3
Canada	1440	28901	520	4.6	2.3	5.2	86.9	4.3
Cyprus	230	523	484	9.7	0.7	9.8	151.3	9.4
Czech Republic	426	7460	513	6.3	1.8	6.6	82.3	5.3
Denmark	480	1547	517	5.1	1.3	5.3	102.1	7.4
France	670	90387	496	3.9	0.9	4.0	69.4	4.3
Germany	487	59545	513	5.6	2.9	6.3	95.2	4.9
Greece	311	10015	490	7.9	1.8	8.1	122.3	7.0
Latvia (LSS)	374	495	523	17.8	1.6	17.8	110.9	12.2
Norway	781	3221	545	3.3	2.8	4.4	68.2	2.7
Russian Federation	714	17949	555	7.3	1.7	7.5	99.5	5.7
Slovenia	566	8274	538	12.9	2.0	13.1	107.7	7.2
Sweden	651	11056	529	5.7	0.7	5.8	85.6	2.9
Switzerland	727	5662	538	4.2	0.9	4.3	88.5	3.8
United States	1617	270205	480	4.2	0.7	4.2	63.2	4.5

S.D. = standard deviation
S.E. = standard error

Table C.22 Sampling and Imputation Standard Errors - Heat Scale Females in Their Final Year of Secondary School

Country	Sample Size	Population Size	Mean of 5 Plausible Values	Error Due to Sampling	Error Due to Imputation	Sampling and Imputation Error	S.D.	S.E. of the S.D.
Australia	244	10647	503	5.9	2.1	6.2	77.2	5.8
Austria	457	18721	420	6.7	0.9	6.8	85.4	4.8
Canada	913	22098	492	7.8	2.2	8.1	80.4	7.1
Cyprus	137	311	461	11.1	1.1	11.2	134.8	11.2
Czech Republic	661	11968	472	4.4	0.7	4.5	74.4	7.3
Denmark	117	394	487	8.2	5.1	9.6	89.9	8.9
France	417	57604	487	4.7	3.3	5.7	65.1	3.5
Germany	222	26328	461	9.7	4.3	10.6	93.1	9.9
Greece	148	4652	460	10.4	1.7	10.5	104.2	8.6
Latvia (LSS)	334	484	484	23.2	2.8	23.4	111.1	8.2
Norway	267	1148	511	6.7	2.0	7.0	69.4	7.5
Russian Federation	519	15026	501	14.7	1.9	14.8	104.5	10.6
Slovenia	160	3162	470	18.4	3.6	18.7	129.9	13.4
Sweden	361	5402	507	4.7	2.6	5.4	71.1	4.6
Switzerland	632	5495	480	5.5	1.4	5.7	80.8	4.1
United States	1497	252579	474	2.6	0.9	2.7	52.7	1.7

S.D. = standard deviation
S.E. = standard error

Table C.23 Sampling and Imputation Standard Errors - Wave Phenomena Scale Males in Their Final Year of Secondary School

Country	Sample Size	Population Size	Mean of 5 Plausible Values	Error Due to Sampling	Error Due to Imputation	Sampling and Imputation Error	S.D.	S.E. of the S.D.
Australia	417	20973	529	8.8	1.8	9.0	100.3	9.1
Austria	306	11559	506	7.2	0.9	7.3	80.3	4.5
Canada	1440	28901	497	4.0	1.4	4.3	83.7	3.5
Cyprus	230	523	519	10.4	0.6	10.4	125.6	9.8
Czech Republic	426	7460	491	7.1	1.3	7.2	74.1	3.7
Denmark	480	1547	547	6.1	1.6	6.3	100.9	6.6
France	670	90387	475	5.3	1.7	5.6	73.0	3.1
Germany	487	59545	551	12.4	2.4	12.7	95.8	6.8
Greece	311	10015	457	7.4	0.8	7.4	97.8	6.5
Latvia (LSS)	374	495	515	17.2	1.8	17.3	92.6	12.3
Norway	781	3221	575	4.4	2.2	4.9	85.6	2.9
Russian Federation	714	17949	539	7.6	2.1	7.9	101.0	4.2
Slovenia	566	8274	538	11.8	1.3	11.9	106.5	8.2
Sweden	651	11056	576	6.1	0.8	6.1	111.3	4.2
Switzerland	727	5662	533	4.6	1.3	4.8	85.4	4.8
United States	1617	270205	460	2.4	1.0	2.6	54.7	2.3

S.D. = standard deviation
S.E. = standard error

Table C.24 Sampling and Imputation Standard Errors - Wave Phenomena Scale Females in Their Final Year of Secondary School

Country	Sample Size	Population Size	Mean of 5 Plausible Values	Error Due to Sampling	Error Due to Imputation	Sampling and Imputation Error	S.D.	S.E. of the S.D.
Australia	244	10647	498	6.1	3.8	7.2	89.4	5.0
Austria	457	18721	444	9.7	0.7	9.7	82.3	10.9
Canada	913	22098	476	6.2	1.8	6.4	73.5	4.6
Cyprus	137	311	486	8.3	1.1	8.4	104.5	7.9
Czech Republic	661	11968	419	4.8	0.6	4.9	62.9	3.4
Denmark	117	394	493	7.9	6.1	10.0	79.7	6.8
France	417	57604	448	3.7	2.7	4.6	70.8	3.8
Germany	222	26328	485	9.7	2.9	10.1	87.7	6.4
Greece	148	4652	444	6.9	2.0	7.2	82.0	5.8
Latvia (LSS)	334	484	480	16.1	1.5	16.2	86.0	11.7
Norway	267	1148	519	9.6	3.6	10.2	91.0	6.2
Russian Federation	519	15026	487	12.2	2.4	12.4	104.7	9.7
Slovenia	160	3162	446	13.0	3.2	13.4	110.7	10.5
Sweden	361	5402	528	5.1	2.9	5.9	91.3	4.7
Switzerland	632	5495	460	4.3	1.0	4.4	76.6	2.4
United States	1497	252579	442	3.0	0.5	3.0	50.1	1.8

S.D. = standard deviation
S.E. = standard error

Table C.25 Sampling and Imputation Standard Errors
Particle, Quantum, Astrophysics, and Relativity
Males in Their Final Year of Secondary School

Country	Sample Size	Population Size	Mean of 5 Plausible Values	Error Due to Sampling	Error Due to Imputation	Sampling and Imputation Error	S.D.	S.E. of the S.D.
Australia	417	20973	533	6.6	1.1	6.7	86.1	6.2
Austria	306	11559	505	9.9	1.2	9.9	82.5	5.5
Canada	1440	28901	513	5.9	0.6	6.0	80.3	4.5
Cyprus	230	523	450	7.7	0.4	7.7	130.3	6.5
Czech Republic	426	7460	498	6.8	1.6	6.9	87.9	5.4
Denmark	480	1547	546	5.9	1.3	6.0	84.8	5.5
France	670	90387	485	4.0	1.6	4.3	61.0	3.6
Germany	487	59545	561	15.1	2.7	15.3	108.3	9.7
Greece	311	10015	456	6.4	0.7	6.4	96.9	7.3
Latvia (LSS)	374	495	505	16.5	1.1	16.6	94.2	10.3
Norway	781	3221	585	4.4	2.3	5.0	80.7	3.2
Russian Federation	714	17949	561	7.8	1.3	7.9	91.9	4.7
Slovenia	566	8274	528	18.6	2.6	18.7	110.5	12.6
Sweden	651	11056	570	3.2	0.5	3.3	76.8	3.1
Switzerland	727	5662	519	5.7	0.9	5.8	87.0	5.9
United States	1617	270205	466	3.4	1.2	3.6	51.4	4.5

S.D. = standard deviation
S.E. = standard error

Table C.26 Sampling and Imputation Standard Errors
Particle, Quantum, Astrophysics, and Relativity
Males in Their Final Year of Secondary School

Country	Sample Size	Population Size	Mean of 5 Plausible Values	Error Due to Sampling	Error Due to Imputation	Sampling and Imputation Error	S.D.	S.E. of the S.D.
Australia	244	10647	497	7.5	2.4	7.8	87.0	5.4
Austria	457	18721	465	5.9	1.6	6.1	79.1	4.6
Canada	913	22098	471	4.9	1.4	5.1	73.6	4.5
Cyprus	137	311	411	9.9	0.4	9.9	126.7	11.0
Czech Republic	661	11968	425	4.5	1.1	4.6	74.2	3.5
Denmark	117	394	529	6.4	3.6	7.4	73.7	7.4
France	417	57604	457	3.8	1.5	4.1	57.7	6.0
Germany	222	26328	508	13.2	2.8	13.5	98.4	8.1
Greece	148	4652	426	5.5	1.6	5.7	79.4	8.3
Latvia (LSS)	334	484	470	20.6	3.0	20.8	92.9	10.5
Norway	267	1148	549	9.8	1.7	9.9	87.1	10.2
Russian Federation	519	15026	520	13.8	2.1	13.9	100.4	9.5
Slovenia	160	3162	458	13.5	4.1	14.1	102.0	8.9
Sweden	361	5402	538	5.9	2.0	6.2	73.2	4.7
Switzerland	632	5495	457	4.2	1.5	4.4	66.8	2.8
United States	1497	252579	446	2.1	0.9	2.3	44.7	1.8

S.D. = standard deviation
S.E. = standard error